

# PATENT ABSTRACTS OF JAPAN

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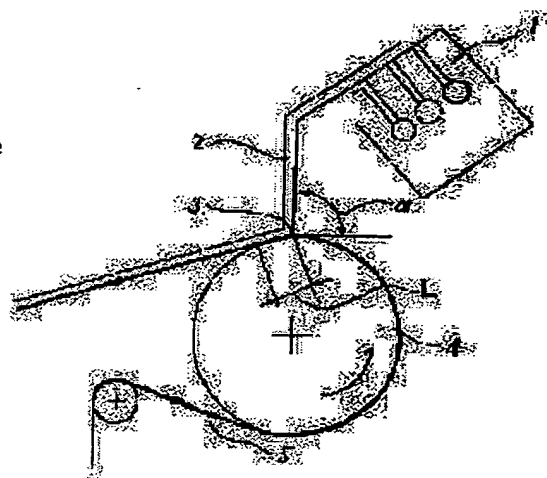
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(21)Application number : 09-143803 (71)Applicant : MITSUBISHI PAPER  
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## (54) COATING METHOD

### (57)Abstract:

PROBLEM TO BE SOLVED: To carry out the multi-layer simultaneous coating of an ink acceptive coating liquid at high speed without generating the defective coating caused by the heeling phenomenon, the air entrainment phenomenon or the like by specifying the surface roughness of a continuously travelling substrate at the specified roughness and also specifying the viscosity of a coating liquid for a lowermost layer at the time of high shearing.



SOLUTION: Coating liquids of two kinds or more are made to fall freely as a coating liquid film 2 by a slide curtain head 1 and impact crosslinked onto a web 5 as a continuously travelling substrate and applied thereon for coating. At that time, the angle  $\theta$  formed by the tangent to a backup roll 4 on a liquid contact section 3 and a coating liquid film 2 is set at  $90^\circ$ , and the distance L of bringing a web 5 into contact with the backup roll 4 is set at 3 mm or more in the travelling direction of the web 5 from the top of the backup roll 4 as a start point. Also the surface roughness of the web 4 is set at 0.1  $\mu$ m or more, while the viscosity of a lowermost layer coating liquid at the time of high shearing is set at 30 cPs or more to 300 cPs or less.

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**CLAIMS**

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[Claim(s)]

[Claim 1] The method of application characterized by having set the aforementioned base material surface roughness to 0.1 micrometers or more, and setting viscosity at the time of high shearing of the lowest layer application liquid to 30cps or more 300cps or less in the curtain method of application painted on the base material which uses at least two or more sorts of application liquid as a thin film liquefied object, it is made to carry out free fall, and carries out a continuity run.

[Claim 2] The method of application characterized by having set the aforementioned base material surface roughness to less than 0.1 micrometers, and setting viscosity at the time of high shearing of the lowest layer application liquid to 5cps or more 25cps or less in the curtain method of application painted on the base material which uses at least two or more sorts of application liquid as a thin film liquefied object, it is made to carry out free fall, and carries out a continuity run.

[Claim 3] The method of application according to claim 1 or 2 characterized by setting to 3mm or more distance which the aforementioned thin film liquefied object is dropped in the back-up-roll crowning, and the aforementioned base material and the aforementioned back up roll touch in the aforementioned base material run orientation with the aforementioned back-up-roll crowning as the starting point.

[Claim 4] The method of application according to claim 1, 2, or 3 characterized by the aforementioned application liquid being ink acceptance layer application liquid.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the technique of carrying out the multilayer simultaneous application of the thin film liquefied object (an application liquid membrane being called hereafter.) with a curtain application method about a manufacture of an ink-jet record sheet at the band-like base material (a web is called hereafter) it runs continuously.

[0002]

[Description of the Prior Art] The ink-jet recording method has spread quickly from excelling in silence, high-speed printing nature, etc. Recent years more high resolution and gloss follow on being required, and various proposals are made. For example, the sheet for record which prepared the ink acceptance layer more than two-layer in the sheet for record and JP,62-253483,A which prepared the transparent high ink absorption layer of an ink acceptability, and JP,7-186521,A, and gave the still high ink absorptivity to JP,60-168651,A and the 61-181679 official report is indicated.

[0003] Moreover, since the repeatability of not only the acceptability of ink but a dot and the drying property of ink are raised, the sheet for ink-jet record with which the ink acceptance layer which comes to contain gelatin is characterized by providing more than two-layer at least, including at least one or more sorts of water-soluble vinyl polymers in gelatin further at the upper layer, and including at least one or more sorts of water-soluble cellulose in gelatin further at the lower layer is indicated by the Japanese-Patent-Application-No. 62836 [ nine to ] specification.

[0004] Furthermore, the expansion of intended use, such as a manuscript of the oban poster using the ink-jet plotter and an over head projector, is progressing in recent years. Even if it makes it what \*\*, it suggests that multilayering of an acceptance layer is progressing, and multilayer simultaneous application method selection of an acceptance layer is an important technical problem.

[0005] As a multilayer simultaneous application method, generally the slide bead method is learned and is used in the field of the photosensitive material as which especially a precision thin-layer application is required.

[0006] A slide bead method can be applied precision thin-layer simultaneous, as described above. However, in connection with the formation of a high-speed application, by condensing application liquid for the purpose of a xeraxis unloading, application liquid viscosity increases as a result and it has the trouble where a vertical-reinforcement-like application defect (called living) at equal intervals occurs in the web run orientation.

[0007] In order to suppress such application defective occurrence, various method of applications are indicated. For example, the method of application which gives a carrier layer is indicated by JP,60-255172,A and the 63-54975 official report.

[0008] It has the trouble of that the liquid-sending system only for carrier layers is needed separately, and an equipment configuration is complicated by this indication technique although it becomes possible to suppress the living in a slide bead method to some extent, and a xeraxis load increasing.

[0009] In recent years, a high-speed application follows on being required from the viewpoint of the

enhancement in a productivity, and a curtain application method has come to be used abundantly. A curtain application method is the technique of making carry out free fall of the application liquid membrane, and applying it on the web it runs continuously, as basic technique, it is indicated by JP,49-24133,B and the 49-35447 official report, and the multilayer simultaneous application of it is attained by the slide curtain coater given [ this ] in an indication.

[0010] The manufacture technique of the ink-jet record sheet characterized by applying an ink acceptance layer to JP,6-183132,A and a 8-108615 official report using a curtain coater on the other hand is indicated. By this indication technique, there is no application defect and it has high printing concentration, and when an ink acceptance layer is more than two-layer since a curtain head is a slot type although the ink-jet record sheet excellent in picture image color nature is obtained, it has the trouble where a multilayer application cannot be carried out simultaneously.

[0011] Furthermore, in the case of the application head of a slot type and an extrusion die, the slit spacing had to be changed according to the amount of application liquid flows, and great time was required in order to adjust this slit spacing equally to the application cross direction.

[0012] Although the aforementioned trouble is canceled by the slide curtain coater given in JP,49-24133,B, various problems were taken up by it in connection with the further high-speed application having come to be demanded in recent years, and the cure has been taken. it is liquid at line of contact (a wetted part is called hereafter) of the phenomenon (the air company phenomenon is called hereafter) and the web which involve in the minute foam between a web and an application liquid membrane, and an application liquid membrane as a phenomenon control the application speed by the curtain application method in JP,3-146172,A -- the phenomenon (a heel phenomenon is called hereafter) which a ball generates, and the phenomenon (the following and liquid -- who -- a phenomenon is called) in\_which of an application liquid membrane do adhere, but flies

[0013] The theoretical handling of these phenomena is explained by work"1997 of Schweizer, and LIQUID FILM COATING" in full detail as S.F.Kistler. The heel phenomenon accompanied by air company is also stated to this work. especially being regarded as questionable at the time of a high-speed high flow rate -- the aforementioned liquid -- whom -- although it is a phenomenon and it is based also on the surface state of application liquid nature and the web used, it is made remarkable when a flow rate exceeds 4.0cc/sec/cm in general

[0014] the result from which the inspissation of application liquid came to be attained for the purpose of a xerensis unloading in recent years -- the aforementioned liquid -- whom -- occurrence of a phenomenon became the inclination which decreases However, even if the flow rate was less than [ 4.0cc/sec/cm ], it was difficult to suppress occurrence of the aforementioned heel phenomenon and the heel phenomenon accompanied by air company along with the versatility of a web surface roughness, and the formation of a high-speed application.

[0015] In the relation between a web surface roughness, application liquid nature, especially viscosity, it was well-known to affect application nature not a little in this contractor. The diagram (AIChEWinter National Meeting, 1982) of Kistler gives this from the theoretical side face. specifying the viscosity and the web surface roughness at the time of low shearing based on this diagram -- liquid -- whom -- the method of application which avoids a phenomenon is indicated by JP,3-143569,A and the 3-146172 official report

[0016] the time of a high flow rate which was described above by this indication technique -- liquid -- although the who phenomenon was avoidable, the viscosity at the time of high shearing was not examined at all On the other hand, paying attention to the point that the shear rate [ in / in this invention person etc. / a wetted part by the formation in recent years of a high-speed application ] is increasing remarkably, and the point that the aforementioned air company phenomenon, a heel phenomenon, etc. are greatly influenced by the viscosity near the wetted part, the viscosity at the time of high shearing found out having done big influence at high-speed application nature by various experiments in the relation with a web surface roughness further.

[0017] As described above, in connection with the formation of a field-of-the-invention expansion of

an ink-jet recording method, the comprehensive and concrete application technique for carrying out the multilayer simultaneous application of the ink acceptance layer application liquid at high speed was not indicated to various webs, i.e., the ink-jet record sheet which has various surface roughnesss.

[0018]

[Problem(s) to be Solved by the Invention] this invention is made in view of the above troubles, and the place made into the purpose is in the technique of carrying out the simultaneous application of at least two or more sorts of application liquid by the curtain coater to offer the technique of carrying out a multilayer simultaneous application at high speed, without the application defect resulting from the heel phenomenon, the air company phenomenon, etc. producing ink acceptance layer application liquid on the base material for ink jets which has various surface roughnesss.

[0019]

[Means for Solving the Problem] In a claim 1, in the curtain method of application painted on the base material which uses at least two or more sorts of application liquid as a thin film liquefied object, it is made to carry out free fall, and carries out a continuity run, the above-mentioned technical problem should set the aforementioned base material surface roughness to 0.1 micrometers or more, and should set viscosity at the time of high shearing of the lowest layer application liquid to 30cps or more 300cps or less. In a claim 2, in the curtain method of application painted on the base material which uses at least two or more sorts of application liquid as a thin film liquefied object, it is made to carry out free fall, and carries out a continuity run, set the aforementioned base material surface roughness to less than 0.1 micrometers, and set viscosity at the time of high shearing of the lowest layer application liquid to 5cps or more 25cps or less. In a claim 3, it is attained by setting to 3mm or more distance which the aforementioned thin film liquefied object is dropped in the back-up-roll crowning, and the aforementioned base material and the aforementioned back up roll touch in the aforementioned base material run orientation with the aforementioned back-up-roll crowning as the starting point.

[0020]

[Embodiments of the Invention] Drawing 1 is a \*\* type configuration side elevation having shown one example of this invention. On the web 5 which is made to carry out free fall of at least two or more sorts of application liquid as an application liquid membrane 2, and carries out a continuity run in the state of a laminating by the slide curtain head 1 given in JP,49-24133,B, collision bridge formation is carried out and it paints.

[0021] In this invention, dropping the application liquid membrane 2 in the back-up-roll 4 crowning is making into 90 degrees angle alpha (collision angle alpha's being called hereafter) which the tangent to a back up roll 4 and the application liquid membrane 2 in a wetted part 3 make.

[0022] Drawing 3 (b) shows the case where the aforementioned collision angle alpha which is the embodiment of this invention is made into 90 degrees. Drawing 3 (c) is drawing having shown the case where the aforementioned collision angle alpha was made larger than 90 degrees, and is indicated by JP,6-51158,B. this indication technique -- comparatively -- a low flow rate, for example, 2.0 cc / sec/, -- a case although air company can be suppressed effectively with cm [ below ], so that this flow rate may be exceeded -- reverse -- a heel phenomenon and liquid -- whom -- since a phenomenon becomes remarkable, it is not desirable

[0023] drawing having, shown the case where drawing 3 (a) made the aforementioned collision angle alpha smaller than 90 degrees, on the other hand -- it is -- a heel phenomenon and liquid -- whom -- although a phenomenon is suppressed, since it becomes easy to generate an air company phenomenon by the collision force fall to the web 5 of the application liquid membrane 2, it is not desirable

[0024] However, when the aforementioned collision angle alpha is made into 90 degrees, selection of distance L which a web 5 and the back up roll 4 touch is important when raising the stability of a wetted part 3.

[0025] In drawing 1, distance L which a web 5 and the back up roll 4 touch is that being referred to as 3mm or more in the run orientation of a web 5 with the crowning of a back up roll 4 as the starting point sets to 5mm or more desirable still preferably. If this contact distance L is less than 3mm,

vibration of a web will spread to a wetted part 3, and will induce line-like failure [ application ]. Especially, it is remarkable at the time of a high-speed application. If this contact distance L fulfills the conditions of being 3mm or more, this contact distance L will be arbitrarily defined by the diameter of a back up roll 4, and the conveyance orientation of a web 5.

[0026] In this invention, the viscosity at the time of high shearing is viscosity [ in less than / more than 105sec-1106sec-1 / in a shear rate ]. In order to give the so-called non-Newton nature from which viscosity changes with shear rates to application liquid, it is common knowledge technique to add a thickener or the non-Newton nature additive (polymeric material). In this invention, shearing viscosity was measured using the opposite jet formula extension viscometer (RFX by the leo metric company).

[0027] Drawing 2 is drawing having shown the relation between a shear rate and viscosity in this invention. A shear rate can take arbitrary viscosity in the viscosity not more than 104sec-1 regardless of the path of straight-line a which shows the behavior of straight-line b which shows the viscosity to a shear rate, i.e., the behavior of a Newtonian fluid, and a non-Newtonian fluid. Field A which can be applied uniform shows the case where a web surface roughness is 0.1 micrometers or more, and field B which can be applied uniform shows the case where a web surface roughness is less than 0.1 micrometers. Here, a uniform application shall not have an application defect and it shall mean that the average of the humid thickness to the orientation of a web width is less than \*\*5% of a predetermined humid thickness.

[0028] Drawing 4 is a cross-sectional view showing an example of the rate-of-flow distribution in about three wetted part. It is asked for a shear rate by \*\*ing the mean velocity in liquid-membrane thick 41 by the liquid thickness 41. The liquid thickness 41 is defined according to the bearer rate of application liquid nature and the web 5, and the domain can be estimated to be 10 to 30% of all the thicknesss 42.

[0029] In this invention, when the surface roughness of a web 5 is 0.1 micrometers or more, as for the viscosity at the time of high shearing of the lowest layer application liquid, it is desirable that it is [ 30cps or more ] 300cps or less, and it is 80cps or more 150cps or less more preferably. When this viscosity is less than 30cps, application failure occurs according to a heel phenomenon. It becomes [ an air company phenomenon ] remarkable and is not desirable if this viscosity exceeds 300cps. Moreover, when the surface roughness of a web 5 is less than 0.1 micrometers, as for the viscosity at the time of this high shearing, it is desirable that it is [ 5cps or more ] 25cps or less, and it is 8cps or more 15cps or less more preferably. It becomes [ the heel phenomenon accompanied by air company ] remarkable and is not desirable if this viscosity exceeds 25cps.

[0030] In this invention, although the upper layer and the two-layer configuration of a lower layer may be used for the configuration of an ink acceptance layer as indicated by the Japanese-Patent-Application-No. 62836 [ nine to ] specification, the multilayer configuration which has an interlayer between the upper layer and a lower layer further may be used for it. You may make it a lamination which exceeds three layers which multilayered this interlayer further. Especially if this interlayer is a material which does not injure the ink-jet printing fitness, he will not be restricted.

[0031] In this invention, although not restricted especially about the viscosity of layers other than the lowest layer, it is desirable to make or less [ 0.5 or more ] into 1.5 the viscosity ratio at the time of low shearing between the layers which adjoin each other on the basis of a lower layer side from the viewpoint of preventing the mixture between layers. Here, the viscosity at the time of low shearing is the viscosity [ shear rate / aforementioned ] of less than / more than 10sec-1100sec-1 / within the limits.

[0032] Although the thickener used for this invention can be altogether used also including a well-known thing The thickener which especially whose thickening effect is remarkable and does not have fear of the failure (for example, congelation, application \*\*\*\* aggravation) occurrence at the time of an application, For example, the water-soluble polymer which has the sulfate machine of a publication in JP,36-21574,B, A dextran and its sulfate given in JP,35-11989,B and a 45-12822 official report, The polymer which has the sulfonic group, the carboxylic-acid machine, or phosphoric-acid machine



of a publication in JP,53-18687,B, Although the styrene and the maleic-anhydride copolymerization object of a publication or styrene and a maleic-anhydride copolymerization object, the condensate of polyvinyl alcohol, etc. are used for JP,48-43135,B, it is not limited to these.

[0033] Selection use of the amphoteric surface active agents, such as a nonionic surfactant represented by the cationic surfactant represented by an anion nature surfactant which is represented by sodium alkylsulfate, alkyl benzene sodium sulfonate, etc., alkylammonium chloride, alkyl pyridinium chloride, etc. as a surfactant in this invention, polyoxyethylene alkyl phenyl ether, alkyl ester, etc., or an alkylamino acid, etc. can be carried out suitably.

[0034] As a web used for this invention, a plastics film, resin coated paper, a synthetic paper, etc. are contained. A polyolefine, polyester, a cellulose acetate, etc. are used as quality of the material of a plastics film. As a resin used for resin coated paper, although polyethylene, the polyolefine, etc. are typical, it is not necessarily limited to this. Moreover, in the case of resin coated paper and a plastics film, they can also be beforehand painted because of wettability enhancement, being able to use water-soluble polymers, such as gelatin, as an under-coating layer.

[0035] When the viscosity at the time of high shearing of the aforementioned lowest layer is 30cps or more 300cps or less, the surface roughness of the web 5 used for this invention has desirable 0.1 micrometers or more, and is 0.2 micrometers or more more preferably. Since the heel phenomenon accompanied by air company will become remarkable even if the viscosity at the time of high shearing of the aforementioned lowest layer is within the limits [ 300cps or less ] 30cps or more if this surface roughness is less than 0.1 micrometers, it is not desirable.

[0036] In addition, if a surface roughness is 0.1 micrometers or more, it will be suitably selected from the feeling of a feel and high-class feeling which are required of a product. For example, when a glossy surface is demanded, the surface roughness of a web 5 has the desirable 0.1 micrometers or more domain of 0.3 micrometers or less, and when a lusterless side is demanded, it is desirable [ a web surface roughness ] that it is 0.5 micrometers or more.

[0037] When the viscosity at the time of high shearing of the aforementioned lowest layer is within the limits [ 25cps or less ] 5cps or more, the surface roughness of a web 5 has desirable less than 0.1 micrometers, and it is 0.05 micrometers or less more preferably. When this surface roughness is 0.1 micrometers or more, the application defect which originated in the air company phenomenon at the time of a high-speed application occurs.

[0038] In this invention, the surface roughness of a web 5 was measured using the surface-roughness profile and form tester (SURFCOMby Tokyo Seimitsu Co., Ltd.500B).

[0039] In this invention, a high-speed application shall mean that a bearer rate paints the application liquid membrane 2 on the web 5 250m / more than min.

[0040] Especially coverage hygroscopic moisture is not restricted in this invention. According to a printing property, xeransis conditions, etc. which are demanded, it is set suitably. A common domain is within the limits of 40g/m<sup>2</sup> to 120g/m<sup>2</sup> in all layers.

[0041]

[Example] According to the following conditions, it applied by the slide curtain coater given in JP,49-24133,B.

Operating condition Web : 140 micrometer thick polyethylene-resin covering paper Three kinds (surface-roughness:0.2micrometer, 0.25 micrometers, and 0.8 micrometers) : 100 micrometer thick polyethylene-terephthalate film Surface-roughness:0.01micrometer Web-width:350mm Application width-of-face:320mm Curtain height:75mm[0042] Application Liquid: Temperature setting:36 degree-C surface tension was measured by the plate method (CBVP[ by the consonance interface science company ]-Z). It adjusted to predetermined viscosity by changing total layer coverage hygroscopic moisture within the limits of 40g/m<sup>2</sup> to 120g/m<sup>2</sup>. In addition, that it is with the section shall mean the weight section. Since this example is a two-layer application, that it is with "the viscosity at the time of the lowest layer quantity shearing" during Table 1, Table 2, and table 3 publication shall show "the viscosity at the time of lower layer quantity shearing."

[0043]

The upper ink acceptance layer application liquid composition Liming gelatin (8% aqueous solution) The 35 sections Polyvinyl pyrrolidone K-30 (8% aqueous solution) The 63 sections G 2-ethylhexyl sulfo succinic-acid soda (1% aqueous solution) The two sections Surface-tension: 25dyne/cm Lower layer ink acceptance layer application liquid composition Liming gelatin (8% aqueous solution) The 35.5 sections The carboxymethyl-cellulose (8% aqueous solution) 63.5 section G 2-ethylhexyl sulfo succinic-acid soda (1% aqueous solution) The one section Surface tension:28dyne/cm[0044]

[Table 1]

	No.	最下層高剪断時の粘度 (cps)	ウェブ表面粗度 ( $\mu\text{m}$ )	衝突角度 $\alpha$ (deg)	接触距離 L (mm)
実施例	1	150	0.25	90	5
		(結果) 塗布速度400m/minまで、良好な光沢面、印字濃度、ドット再現性が得られた。			
実施例	2	100	0.20	90	5
		(結果) 塗布速度350m/minまで、良好な光沢面、印字濃度、ドット再現性が得られた。			
実施例	3	80	0.25	90	5
		(結果) 塗布速度250m/minまで、良好な光沢面、印字濃度、ドット再現性が得られた。			
実施例	4	100	0.80	90	5
		(結果) 塗布速度400m/minまで、良好な艶消し面、印字濃度、ドット再現性が得られた。			

[0045]

[Table 2]

	No.	最下層高剪断時の粘度 (cps)	ウェブ表面粗度 ( $\mu\text{m}$ )	衝突角度 $\alpha$ (deg)	接触距離 L (mm)
比較例	5	150	0.01	90	5
		(結果) 塗布速度150m/minで空気同伴による縦筋状の塗布欠陥が発生した。			
比較例	6	150	0.01	110	5
		(結果) 塗布速度150m/minにて、空気同伴を伴ったヒール現象により縦筋状塗布欠陥が多発。			
実施例	7	150	0.25	90	1
		(結果) 塗布速度250m/minまで、良好な光沢面、印字濃度、ドット再現性が得られた。			
実施例	8	150	0.25	70	5
		(結果) 塗布速度250m/minまで、良好な光沢面、印字濃度、ドット再現性が得られた。			

[0046]

[Table 3]

	No.	最下層高剪断 時の粘度 (cps)	ウェブ 表面粗度 ( $\mu\text{m}$ )	衝突角度 $\alpha$ (deg)	接触距離 L (mm)
実施例	9	10	0.01	90	5
		(結果) 塗布速度350m/minまで、良好な面質、ドット再現性が得られた。			
比較例	10	10	0.80	110	1
		(結果) 塗布速度200m/minにて、空気同伴を伴った現象により縦筋状の塗布欠陥が発生した。			
実施例	11	10	0.01	90	1
		(結果) 実施例No.7と同じ結果。			
比較例	12	10	0.80	90	5
		(結果) 塗布速度250m/min以上にて、空気同伴による縦筋状塗布欠陥の発生が顕著であった。			

[0047]

[Effect of the Invention] The technique of carrying out a multilayer simultaneous application at high speed was able to be offered, without the application defect resulting from the heel phenomenon, the air company phenomenon, etc. producing ink acceptance layer application liquid on the various base materials for ink jets by this invention in the technique of carrying out the simultaneous application of at least two or more sorts of application liquid by the curtain coater.

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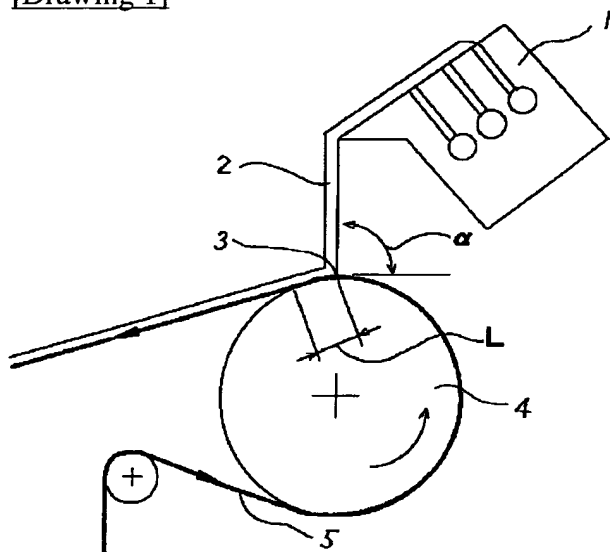
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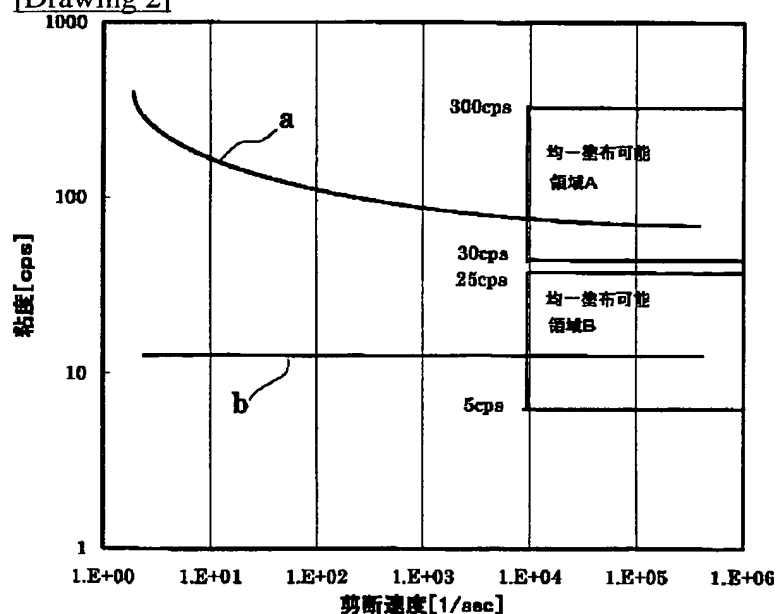
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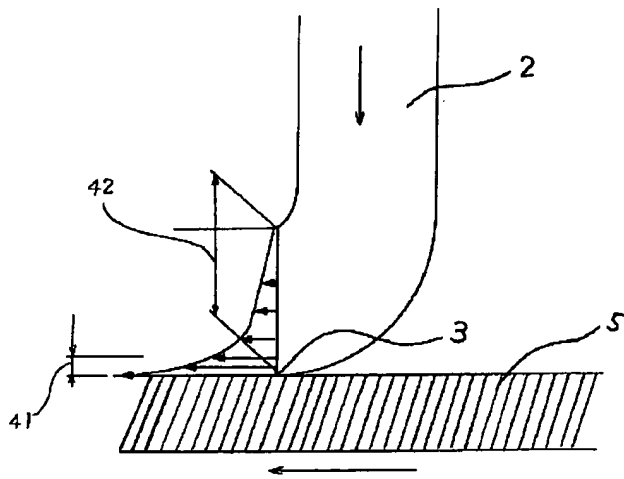
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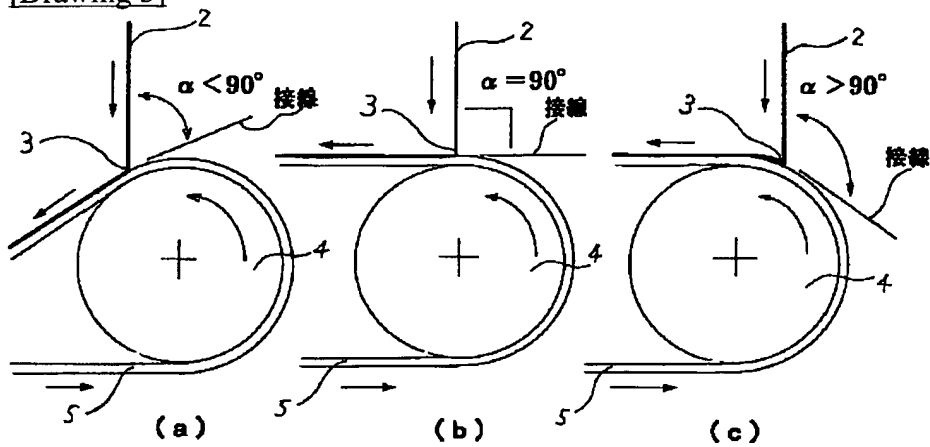
[Drawing 2]



[Drawing 4]



[Drawing 3]



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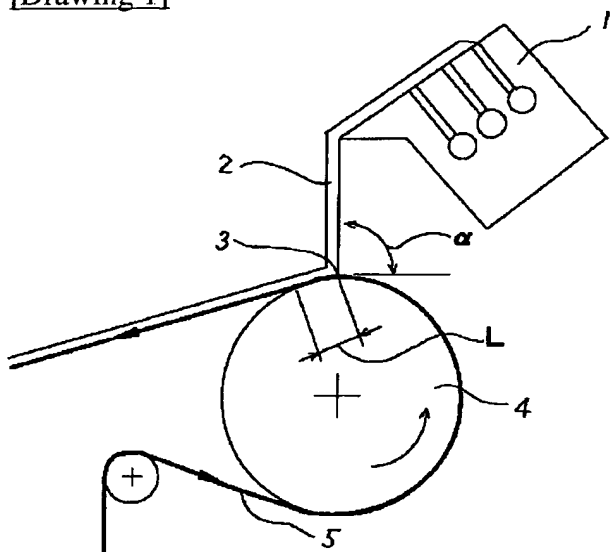
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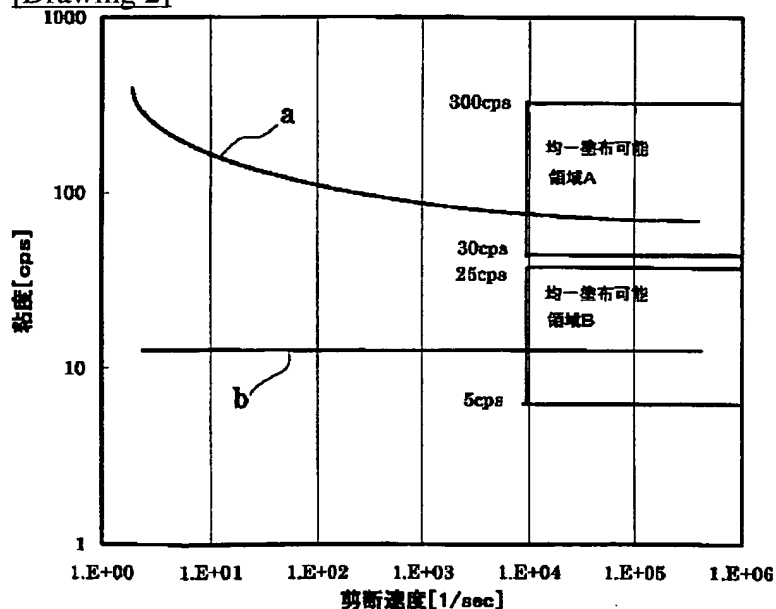
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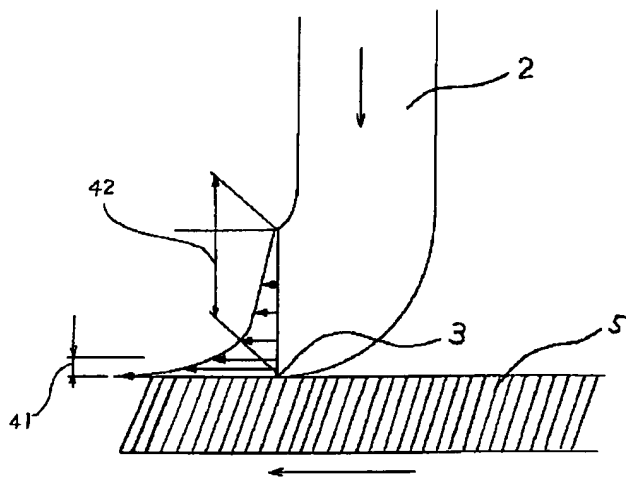
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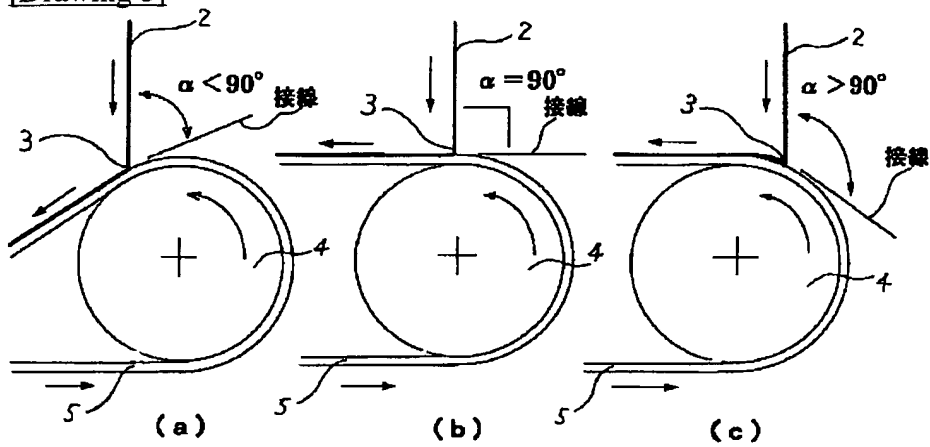
[Drawing 2]



[Drawing 4]



[Drawing 3]



[Translation done.]

**\* NOTICES \***

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- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

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**DESCRIPTION OF DRAWINGS**

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[Brief Description of the Drawings]

[Drawing 1] The \*\* type configuration side elevation of one example of this invention.

[Drawing 2] Drawing having shown the relation between a shear rate and viscosity in this invention.

[Drawing 3] Drawing having shown the application liquid-membrane fall position.

[Drawing 4] The cross-sectional view having shown an example of the rate-of-flow distribution of a wetted part.

[Description of Notations]

1 Slide Curtain Head

2 Application Liquid Membrane

3 Wetted Part

4 Back Up Roll

5 Web

41 Liquid Thickness

42 All Thicknesss

alpha Collision angle

L Contact distance of a back up roll and a web

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[Translation done.]